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Comparison of short-term surgical and oncological outcomes of laparoscopic versus open surgery, in gastric cancer

Minimally invasive gastric cancer surgery

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Abstract
Aim: The aim of this study was to compare the short-term outcomes of gastrectomy operations performed using laparoscopic and open surgical methods in patients with gastric cancer in light of the current literature.
Material and Methods: This retrospective analysis included data of 65 patients with gastric cancer who underwent elective curative laparoscopic or open gastrectomy and D2 lymph node dissection between January 2017 and 2020 in the gastroenterological surgery and surgical oncology departments of the Samsun Training and Research Hospital.
Results: The open gastrectomy group included 31 patients with a median age of 63 (42–91) years. The laparoscopic gastrectomy group included 34 patients with a median age of 57 (24–81) years. There were no statistically significant differences between the two groups in terms of BMI, ASA score, tumor size, degree of invasion, or number of lymph nodes removed. Resection margin involvement was observed in 1 patient in the laparoscopic surgery group. Compared with the open gastrectomy group, the laparoscopic gastrectomy group demonstrated a significantly lower amount of intraoperative blood loss (75±15 mL vs 350±30 mL). The mean operative time was significantly longer(229±43 min vs 175±50 min). There was no statistically significant difference in the length of hospital stay (8 days vs 7 days) and mortality rates (5,8% vs 9,6%). Postoperative overall morbidity was lower (11% vs 16%, p>0,05). The surgical complication rate was lower in the laparoscopic group (2,9% vs 9,6%, p<0,05).
Discussion: Laparoscopic gastrectomy and D2 lymph node dissection may be a potential therapeutic option in patients with early and locally advanced tumors.

Keywords
Gastric cancer; Laparoscopic gastrectomy; Open gastrectomy; Short-term outcomes

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Introduction

Gastric cancer is one of the leading causes of cancer-related deaths, and surgery continues to be the curative treatment option in over 90% of patients with early-stage gastric cancer [1]. Since Kitano [2] performed the first laparoscopic distal gastrectomy for gastric adenocarcinoma in 1994, this minimally invasive method has increased in popularity [3]. A meta-analysis and prospective randomized studies have indicated that laparoscopic total gastrectomy with D2 lymph node dissection is a safe procedure for the treatment of gastric cancer, reduces morbidity and hospital length of stay, and has no adverse effect on short-term oncological outcomes [4,5]. Similar studies have yielded comparable results with laparoscopic distal gastrectomy both in early-stage gastric cancer [6,7] and locally advanced gastric cancer [1].

The aim of our study was to compare short-term outcomes in patients who underwent laparoscopic or open gastrectomy and lymph node dissection for gastric cancer, in light of the current literature.

Material and Methods

This retrospective analysis included data of 65 patients with gastric cancer who underwent elective curative laparoscopic or open gastrectomy and D2 lymph node dissection between January 2017 and January 2020 in the gastroenterological surgery and surgical oncology departments of the Samsun Training and Research Hospital. The study protocol was approved by the Samsun Training and Research Hospital Ethics Committee (No: 2019/13). The laparoscopic and open surgery groups were evaluated retrospectively in terms of age, sex, ASA score, body mass index (BMI), tumor diameter, depth of tumor invasion within the gastric wall (pT), number of lymph nodes removed, resection margin, intraoperative blood loss, operative time, reoperation, length of hospital stay, mortality rate, and morbidity rate and causes.

Statistical Analysis

IBM SPSS Statistics version 21 (IBM Corp., Armonk, NY) software package was used for data analysis. The Kolmogorov–Smirnov test was used to test the normality of the data distributions. Since not all of the data were normally distributed, the data were presented as mean, median, minimum, and maximum values and compared between groups using the Mann–Whitney U test. The Chi-square test was used for between-group comparisons of percentage values.

Results

The open gastrectomy group included 31 patients (11 women and 20 men) with a median age of 63 (42–91) years. The laparoscopic gastrectomy group included 34 patients (9 women and 25 men) with a median age of 57 (24–81) years. There was no statistically significant difference between the groups in terms of gender, whereas the median age was significantly higher in the open surgery group. The median BMI was 25 (18–34) in open gastrectomy patients and 24 (17-40) in the laparoscopic gastrectomy patients. In the open gastrectomy group, 1 patient was ASA 4, 12 were ASA 3, and 18 were ASA 2. In the laparoscopy group, 14 patients were ASA 3, 13 were ASA 2, and 7 were ASA 1. There was no statistically significant difference between the two groups in terms of BMI or ASA. Among the 34 patients who underwent laparoscopic surgery, 20 underwent total gastrectomy and 14 underwent subtotal gastrectomy. Among the 31 patients who underwent open surgery, 22 underwent total gastrectomy while 9 underwent subtotal gastrectomy. The median tumor size was 5.5 (2–11) cm in the open surgery group and 5 (2–10) cm in the laparoscopy group. In the open surgery group, tumor stage was T4a in 19 patients, T3 in 8, T1b in 2, and T1a in 1 patient, while 1 patient was reported to have invasive cancer based on the result of the preoperative endoscopic biopsy and high-grade dysplasia was detected in the main surgical specimen. In the laparoscopy group, tumor stage was T4a in 21 patients, T3 in 6, T2 in 4, and T1a in 2 patients, and 1 patient was reported to have invasive cancer based on the result of the preoperative endoscopic biopsy, but no tumor was detected in the main surgical specimen. The median number of lymph nodes removed was 22 (8–48) in the open surgery group and 18 (6–45) in the laparoscopic surgery group. There was no significant difference between the two groups in terms of tumor size, degree of invasion, or the number of lymph nodes removed. Laparoscopic subtotal gastrectomy was converted to total gastrectomy in 1 patient due to the positive proximal resection margin. The operative time was 175±50 minutes for open surgeries and 229±43 minutes for laparoscopic surgeries. The difference in operative time between the groups was statistically significant (Table -1). Three patients in the open surgery group died due to postoperative acute respiratory distress syndrome, acute myocardial infarction, liver abscess and sepsis, while 2 patients in the laparoscopy group died due to postoperative acute myocardial infarction and cerebrovascular event. The prevalence of postoperative surgical and non-surgical complications in the open surgery group was 9,6% and 6,4% respectively and included pneumonia, pneumothorax, intraabdominal abscess, splenic infarction and abscess, and anastomotic leak. In the laparoscopic group, the rate of postoperative surgical and non-surgical complications was 2,9% and 8,8% respectively and the causes included intracranial hemorrhage, pneumonia, pulmonary embolism, intraabdominal hemorrhage. There was no significant difference between the groups in terms of mortality (for open and laparoscopic surgery, 9,67% vs 5,68%, respectively). The median length of hospital stay in the open and laparoscopic surgery groups was 7 (5–22) days and 8 (5–42) days, respectively, which was not a statistically significant difference (Table 2).

In our patient population, the median follow-up was 18 months (3-34 months) in the laparoscopic gastrectomy group and 16 months (5-35 months) in the open gastrectomy group (p>0,05). In the laparoscopic and open groups, respectively, 4 and 3 patients were lost to follow-up. Four and 3 patients died during the follow-up respectively. In the laparoscopic group, 3 of them died because of cancer and 1 because of another disease. In the open group, 2 of them died because of cancer and 1 because of another disease.

Table 1. Comparision of Clinicopathological Factors Between Groups

	Laparoscopic surgery n=34	Open surgery n=31	p-value
Age (years)	*57	*63	p<0,05
Sex n (%)			
Female	9 (26,5%)	11 (35,4%)	p>0,05
Male	25 (73,5%)	20 (64,6%)	
BMI (kg/m^2)	*24	*25	p>0,05
ASA n (%)			
ASA 1	7 (20,6%)	-	p>0,05
ASA 2	13 (38,2%)	18 (58,1%)	
ASA 3	14 (41,2%)	12 (38,7%)	
ASA 4	-	1 (3,2%)	
Type of Gastrectomy			
Distal	20	22	p>0,05
Total	14	9	
Operative Time (min.)	**229±43 min	**175±50 min	p<0,05
Intraoperative Blood Loss (mL)	**75±15 mL	**350±30 mL	p<0,05
Tumor Size cm	*5 cm	*5,5 cm	p>0,05
Lymph Nodes Removed n	*18	*22	p>0,05
T n (%)			
T1a	2 (5,8%)	1 (3,2%)	p>0,05
T1b	-	2 (6,5%)	
T2	4 (11,8%)	-	
T3	6 (17,6%)	8 (26%)	
T4a	21 (61,8%)	19 (61,3%)	
T4b	-	-	
Residual Tumor n (%)	1 (2,9%)	-	p>0,05

BMI: Body Mass Index, ASA: American Society of Anesthesiologist Physical Satatus Classification, *: Median Value, **: Mean Value

Table 2. Morbidity, Mortality, Hospital Length of Stay

	Laparoscopic surgery n=34	Open surgery n=31	p-value
Morbidity	4 (11,7 %)	5 (16,1 %)	p>0,05
*Non-Surgical;	3 (8,8 %)	2 (6,4 %)	p>0,05
Pneumonia	1 (2,9 %)	1 (3,2 %)	
Pneumothorax	-	1 (3,2 %)	
Pulmonary embolism	1 (2,9 %)	-	
Intracranial Hemorrhage	1 (2,9 %)	-	
*Surgical	1 (2,9 %)	3 (9,6 %)	p<0,05
Intra-abdominal hemorrhage	1 (2,9 %)	-	
Splenic infarct/abscess	-	1 (3,2 %)	
Anastomotic leak	-	1 (3,2 %)	
Intraabdominal abscess	-	1 (3,2 %)	
Mortality	2 (5,8 %)	3 (9,67 %)	p>0,05
ARDS	0	1 (3,2 %)	
Liver abscess and sepsis	0	1 (3,2 %)	
CVE	1 (2,9 %)	0	
AMI	1 (2,9 %)	1 (3,2 %)	
Lenght of Hospital Stay	*8 days	*7 days	p>0,05

ARDS: Acute respiratory distress syndrome, CVE: Cerebrovascular event, AMI: Acute myocardial infarction, *: mean value

Discussion

Gastrectomy is the cornerstone of curative treatment in gastric cancer. The popularity of minimally invasive techniques for gastrectomy has steadily increased over the last 10 years to improve the postoperative period [2].

Differences in age, BMI, ASA score between laparoscopic and open gastric cancer surgery, can be considered patient selection bias [8]. In our study, there was no statistically significant difference between the groups in terms of gender, BMI or ASA score. However, the median age was 63 years in the open surgery group and 57 in the laparoscopic surgery group, which is a statistically significant difference. When selecting patients, we also considered performance status, in addition to age. In terms of age range, the oldest patient in the laparoscopy group was 84 years old, compared to 91 years in the open surgery group. This difference stems from the fact that, anesthetists usually recommend open surgery for patients who is older and has a high ASA score to shorten the duration of surgery. With increased experience, however, their preferences have changed in recent times.

In our study, 20 gastric cancer patients underwent laparoscopic total gastrectomy, 14 underwent laparoscopic distal gastrectomy and D2 lymph node dissection. Laparoscopic distal gastrectomy was converted to total gastrectomy in 1 patient due to positive proximal resection margin. The majority of our patient population were patients with T3 and T4 tumors for both groups (79,4% for laparoscopic, 87,3% for open gastrectomy group). This represents the general characteristics of Western patients with gastric cancer [8]. The median number of lymph nodes removed was 18 (6-45) in the laparoscopic surgery and 22 (8-48) in the open surgery group (p>0,05). As mentioned in different studies [8-10], involving patients with early and locally advanced gastric cancer, our results support that the number of lymph nodes removed in the laparoscopic surgery is comparable with open surgery. In the laparoscopic surgery group, more than 15 lymph nodes, considered the minimum number of lymph nodes for accurate and adequate postoperative staging [11], were collected in 85,2% of our patients.

Intraoperative blood loss is associated with the incidence of early and late adverse effects of surgery and the prognosis of many malign tumors, including gastric cancer [12,13]. Therefore, careful operative techniques should be utilized to minimize intraoperative blood loss. In our study, the laparoscopic gastrectomy group exhibited a significantly lower amount of intraoperative blood loss (75±15 mL vs 350±30 mL, p<0,05). There are studies reporting similar findings for both early and locally advanced gastric cancer [6,8,9,14-16]. However, the use of laparoscopic gastrectomy in all patients with resectable gastric cancer can make the procedure more complex. As a result, more blood loss can be seen [15].

Operative time is an important variable, that reflects the difficulty of surgery and consequently the potential safety of the technique. Lack of tactile sensation, narrow surgical area, complicated vascular anatomy in the splenic hilum and difficulty of D2 lymph node dissection make laparoscopic surgery a time-consuming procedure [4,8]. Operative time was also significantly longer in the laparoscopic surgery group in our study.

In our study, no significant differences in the overall postoperative complication rates were observed between the laparoscopic group (4 patients, 11,7%) and the open group (5 patients, 16,1%, p<0,05). Different studies comparing laparoscopic and open surgery patients have demonstrated consistent morbidity rates (4,2 % - 23,3 %) [5,17-22]. In various studies, morbidity rates for open gastrectomy varied between 16,4% and 24,5% [5,23]. Moreover, in our study, in three out of the four laparoscopic cases, there were non-surgical complications due to pneumonia, pulmonary embolism and intracranial hemorrhage. Hence, the incidence of surgical complications in the laparoscopy group was quite lower and significant (2,9% vs 9,6%, p<0,05). Since the majority of our patient population comprised patients with locally advanced tumors, our study suggests that the advantages of laparoscopy for postoperative complications might be more substantial among locally advanced gastric cancers. In the laparoscopy group, there was only one surgical complication that required relaparotomy due to postoperative hemorrhage. Although, there was no statistical difference between the groups, there are studies [21,22] showing higher rates of reoperation and postoperative hemorrhage in laparoscopic surgeries. This was attributed to technical difficulties during laparoscopic gastrectomy, especially difficulty in forming the esophagojejunal anastomosis [24].

Mortality rates for laparoscopic gastrectomy have been reported between 0,6% to 0,8% [19,21]. In our study, postoperative mortality rates were higher (for open and laparoscopic surgery, 3 patients, 9,67% vs 2 patients, 5,68%, respectively). However, in the laparoscopic surgery group, two patients died due to cerebrovascular events and acute myocardial infarction, which can be classified as patient-related factors.

Better perioperative outcomes, such as less perioperative pain, earlier resumption of bowel movements and the resulting earlier oral intake were reported to reduce the time to discharge after laparoscopic surgery [8,20,25]. In our study, no significant difference was observed between the length of hospital stay in both patient groups for whom the regimen was initiated on the third postoperative day. However, one of our laparoscopic surgery patients with a previous history of cerebrovascular event had the longest hospital stay (42 days) due to postoperative intracranial hemorrhage. This unduly skewed our results due to the small number of patients in the study.

Our study has some limitations. Firstly, it is a single-center study with a limited patient size and designed retrospectively. Secondly, our follow-up period is not enough to make a conclusion for long term results. Thirdly, although the majority of our patients had locally advanced disease, systemic treatment could be applied as adjuvant therapy, due to the insufficient interpretation of computed tomography results. However, in recent times diagnostic laparoscopy and peritoneal washing cytology, neoadjuvant therapy, adjuvant hyperthermic intraperitoneal chemotherapy and cytoreductive surgery with intraperitoneal hyperthermic chemotherapy have been used in our patients by obtaining personal opinions of radiologists for the clinical staging.

Based on the short-term outcomes of our gastric cancer surgeries in our patient population, comprising mostly of locally advanced gastric cancer, laparoscopic gastrectomy with D2 lymph node dissection had lower blood loss, surgical complication rate and a comparable number of removed lymph nodes, resection margin, length of hospital stay, overall complication and mortality rates. However, it is associated with the longer operative time. This supports the use of laparoscopic gastrectomy with D2 lymph node dissection as a safe and effective method.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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References

1. Yu J, Huang C, Sun Y, Cao H , Hu J, Wang K, et al. Effect of laparoscopic vs open distal gastrectomy on 3-year disease-free survival in patients with locally advanced gastric cancer. The CLASS-01 Randomized Clinical Trial. JAMA 2019;321(20):1983-92.

2. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy assisted Billroth I gastrectomy. Surg Laparosc Endosc. 1994;4(2):146-8.

3. Beyer K, Baukloh AK, Kamphues C, Seeliger H, Heidecke C-D, Kreis ME, et al. Laparoscopic versus open gastrectomy for locally advanced gastric cancer: a systematic review and meta-analysis of randomized controlled studies. World Journal of Surgical Oncology. 2019;17(1):68.

4. Malzac P, Torbicz G, Rubinkiewicz M, Gajewska N , Sajuk N, RozmusK, et al. Comparision of totally laparoscopic and open approach in total gastrectomy with D2 lymphadenectomy – systematic review and meta-analysis. Cancer Management and Research 2018;10:6705-14.

5. Etoh T, Honda M, Kumamaru H, Miyata H , Yoshida K, Kodera Y, et al. Morbidity and mortality from a propensity score matched, prospective cohort study of laparoscopic versus open total gastrectomy for gastric cancer: Data from a nationwide web-based database. Surg Endosc 2018;32(6):2766–73.

6. Kim W, Kim HH, Han SU, Kim MC, Hyung WJ, Ryu SW, et al. Decreased morbidity of laparoscopic distal gastrectomy compared with open distal gastrectomy for stage I gastric cancer. Short-term outcomes form a multicenter randomized controlled trial (KLASS-01). Ann Surg. 2016;263(1):28–35.

7. Kim YW, Yang H. Randomized controlled trials evaluating laparoscopic vs. open distal gastrectomy for gastric cancer in 2016: A trilogy finally! Transl Gastroenterol Hepatol. 2017;2:24.

8. Wang W, Zhang X, Shen C, Zhi X, Wang B, Xu Z, et al. Laparoscopic versus open total gastrectomy for gastric cancer: an updated meta-analysis. Plosone 2014;9(2):e88753.

9. Haverkamp L, Ruurda JP, Offerhause GJA, Weijs TJ, van der Sluis PC, van Hillegersberg R, et al. Laparoscopic gastrectomy in Western European patients with advanced gastric cancer. Eur J Surg Oncol. 2016;42(1):110-5.

10. Priego P, Cuadrado M, Ballestero A, Galindo J, Lobo. Comparison of Laparoscopic Versus Open Gastrectomy for Treatment of Gastric Cancer: Analysis of a Textbook Outcome. J Laparoendosc Adv Surg Tech A. 2019;29(4):458-64.

11. Ajani FA, D'Amico AT, Almhanna K, Bentrem DJ, Chao J, Das P, et al. Gastric cancer, Version 3. 2016, NCCN Clinical Practice Guidelines in Oncology. Jnatl Compr Canc Net. 2016;14(10):1286-312.

12. Mörner ME, Gunnarsson U, Jestin P, Svanfeldt M. The importance of blood loss during colon cancer surgery for long term survival: an epidemiological study based on a population based register. Ann Surg. 2012;255(6):1126-8.

13. Liang YX, Guo HH, Deng JY, Wang B-G, Ding X-W, Wang X-N, et al. Impact of intraoperative blood loss on survival after curative resection for gastric cancer. World J Gastroenterol. 2013;19(33):5542-50.

14. Topal B, Leys E, Ectors N, Aerts R, Penninckx F. Determinants of complications and adequacy of surgical resection in laparoscopic versus open total gastrectomy for adenocarcinoma. Surg Endosc 2008;22(4):980-4.

15. Haverkamp L, Weijs TJ, van der Sluis PC, van der Tweel I, Ruurda JP, Richard van Hillegersberg, et al. Laparoscopic total gastrectomy versus open total gastrectomy for cancer: a systematic review and meta-anlaysis. Surg Endosc 2013;27(5):1509-20.

16. Chen X, Xu XW, Zhang RC, Yu Pan, Wu D, Mouet Y-P, et al. Systematic review and meta-analysis of laparoscopy- assisted and open total gastrectomy for

gastric cancer. World J Gastroeneterol 2013;19(32):5365-76.
17. Kim HH, Hyung WJ, Cho GS, Kim MC, Han S-U, Kim W, et al. Morbidity and mortality of laparoscopic gastrectomy for gastric cancer: an interim report-a phase III multicenter, prospective, randomized Trial (KLASS Trial). Ann Surg. 2010;251(3):417-20.
18. Kitano S, Shriashi N, Uyama I, Sugihara K, Tanigawa N, et al. A multicenter study on oncologic outcome of laparoscopic gastrectomy for eraly cancer in Japan. Ann Surg. 2007;245(1):68-72.
19. Jeong O, Jung MR, Kim GY, Kim HS, Ryu YS, Park YK, et al. Comparison of shortterm surgical outcomes between laparoscopic and open total gastrectomy for gastric carcinoma: case control study using propensity score matching method. J Am Coll Surg. 2013;216(2):184–91.
20. Xiong JJ, Nunes QM, Huang Wei, Tan C-L, Ke N-W, Xie S-M, et al. Laparoscopic vs open total gastrectomy for gastric cancer: a meta-analysis. World J Gastroenterol. 2013;19(44):8114–32.
21. Lee J-H, Ahn S-H, Park DJ, Kim H-H, Lee H-J, Yang H-K, et al. Laparoscopic total gastrectomy with D2 lymphadenectomy for advanced gastric cancer. World J Surg. 2012;36(10):2394–9.
22. Lee JH, Nam BH, Ryu KW, Ryu SY, Kim YW , Park YK, et al. Comparison of the long term results of patients who underwent laparoscopy versus open distal gastrectomy. Surg Endosc. 2016;30(2):430-6.
23. Orsenigo E, Di Palo S, Tamburuni A, Staudacher C. Laparoscopy assisted gastrectomy versus open gastrectomy for gastric cancer: a mono institutional Western center experience. Surg Endosc. 2011;25(1):140-5.
24. xJiang HP, Lin LL, Jiang X, Hai-Quan Qiao. Meta-analysis of hand-sawen versus mechanical gastrojejunal anastomosis during laparoscopic Roux-and-Ygastric by-pass for morbid obesity. Int J Surg. 2016;32:150-7.
25. Hu Y, Huang C, Sun Y, Su X, Cao H, Huet J, et al. Morbiditiy and mortality of laparoscopic versus open D2 distal gastrectomy for advanced gastric cancer: a randomized controlled trial. J Clin Oncol. 2016;34(12):1350-7.

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